

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Shunpei YAMAZAKI et al. Art Unit : Unknown
Serial No. : Unassigned Examiner : Unknown
Filed : August 8, 2001
Title : AREA SENSOR AND DISPLAY APPARATUS PROVIDED WITH AN AREA
SENSOR

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Prior to examination, please amend the application as follows:

In the claims:

Amend claims 1-4, 6-8, 10-16, 21-23, 25-28 and 30-48 as follows:

1. An area sensor comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an
electroluminescence element and a plurality of thin film transistors,
wherein:
the photodiode includes a photoelectric conversion layer that is in contact with a part of a
P-type semiconductor layer and an N-type semiconductor layer,
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the
N-type semiconductor layer.

2. An area sensor comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an
electroluminescence element and a plurality of thin film transistors,
wherein:
light emitted from the electroluminescence element is reflected from a subject to be
radiated to the photodiode,
the photodiode generates an image signal from the light reflected to the photodiode,

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the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer an N-type semiconductor layer,
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

3. An area sensor comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,
wherein:
the plurality of thin film transistors control light emission of the electroluminescence element,
light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,
the photodiode and the plurality of thin film transistors generate an image signal from the light reflected to the photodiode,
the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer,
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

4. An area sensor comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element, a switching TFT, an electroluminescence driving TFT, a reset TFT, a buffer TFT and a selective TFT, wherein:
the switching TFT and the electroluminescence driving TFT control light emission of the electroluminescence element,
light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,

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the photodiode and the plurality of thin film transistors generate an image signal from the light reflected to the photodiode,

the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer,

the photoelectric conversion layer is made of an amorphous semiconductor film, and

the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

6. An area sensor according to claim 2, wherein the N-type semiconductor layer comprises polysilicon.

7. An area sensor according to claim 3, wherein the N-type semiconductor layer comprises polysilicon.

8. An area sensor according to claim 4, wherein the N-type semiconductor layer comprises polysilicon.

10. An area sensor according to claim 2, wherein the P-type semiconductor layer comprises polysilicon.

11. An area sensor according to claim 3, wherein the P-type semiconductor layer comprises polysilicon.

12. An area sensor according to claim 4, wherein the P-type semiconductor layer comprises polysilicon.

13. An area sensor according to claim 1, wherein the photoelectric conversion layer comprises amorphous silicon.

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14. An area sensor according to claim 2, wherein the photoelectric conversion layer comprises amorphous silicon.

15. An area sensor according to claim 3, wherein the photoelectric conversion layer comprises amorphous silicon.

16. An area sensor according to claim 4, wherein the photoelectric conversion layer comprises amorphous silicon.

21. An area sensor according to claim 1, wherein the area sensor is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

22. An area sensor according to claim 2, wherein the area sensor is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

23. An area sensor according to claim 3, wherein the area sensor is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

24. An area sensor according to claim 4, wherein the area sensor is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

25. A display apparatus comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,
wherein:

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the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer,
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

26. A display apparatus comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,
wherein:
a light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,
the photodiode generates an image signal from the light reflected to the photodiode,
the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer,
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

27. A display apparatus comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,
wherein:
the plurality of thin film transistors control light emission of the electroluminescence element,
a light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,
the photodiode and the plurality of thin film transistors generate an image signal from the light reflected to the photodiode,

the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer,

the photoelectric conversion layer is made of an amorphous semiconductor film, and

the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

28. A display apparatus comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element, a switching TFT, an electroluminescence driving TFT, a reset TFT, a buffer TFT and a selective TFT, wherein:

the switching TFT and the electroluminescence driving TFT control light emission of the electroluminescence element,

light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,

the photodiode and the plurality of thin film transistors generate an image signal from the light reflected to the photodiode,

the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer,

the photoelectric conversion layer is made of an amorphous semiconductor film, and

the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

30. A display apparatus according to claim 26, wherein the N-type semiconductor layer comprises polysilicon.

31. A display apparatus according to claim 27, wherein the N-type semiconductor layer comprises polysilicon.

32. A display apparatus according to claim 28, wherein the N-type semiconductor layer comprises polysilicon.

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33. A display apparatus according to claim 25, wherein the P-type semiconductor layer comprises polysilicon.

34. A display apparatus according to claim 26, wherein the P-type semiconductor layer comprises polysilicon.

35. A display apparatus according to claim 27, wherein the P-type semiconductor layer comprises polysilicon.

36. A display apparatus according to claim 28, wherein the P-type semiconductor layer comprises polysilicon.

37. A display apparatus according to claim 25, wherein the photoelectric conversion layer comprises amorphous silicon.

38. A display apparatus according to claim 26, wherein the photoelectric conversion layer comprises amorphous silicon.

39. A display apparatus according to claim 27, wherein the photoelectric conversion layer comprises amorphous silicon.

40. A display apparatus according to claim 28, wherein the photoelectric conversion layer comprises amorphous silicon.

41. A display apparatus according to claim 25, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

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42. A display apparatus according to claim 26, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

43. A display apparatus according to claim 27, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

44. A display apparatus according to claim 28, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

45. A display apparatus according to claim 25, wherein the display apparatus is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

46. A display apparatus according to claim 26, wherein the display apparatus is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

47. A display apparatus according to claim 25, wherein the display apparatus is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

48. A display apparatus according to claim 25, wherein the display apparatus is included in electronic equipment selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

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REMARKS

The amendments to the claims made herein are to correct minor grammatical errors and to place the application in better form for examination. No new matter is added.

Attached is a marked-up version of the changes being made by the current amendment.

Applicants ask that all claims be examined. Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: August 8, 2001



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Version with markings to show changes made

In the claims:

Claims 1-4, 6-8, 10-16, 21-23, 25-28 and 30-48 have been amended as follows:

1. (Amended) An area sensor comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,
wherein:
the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

2. (Amended) An area sensor comprising a sensor portion, the sensor portion comprising:
a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,
wherein:
[a] light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,
the photodiode generates an image signal from the light **[radiated]** reflected to the photodiode,
the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

3. (Amended) An area sensor comprising a sensor portion, the sensor portion comprising:

a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,

wherein:

the plurality of thin film transistors control light emission of the electroluminescence element,

[a] light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,

the photodiode and the plurality of thin film transistors generate an image signal from the light **[radiated]** reflected to the photodiode,

the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**

the photoelectric conversion layer is made of an amorphous semiconductor film, and the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

4. (Amended) An area sensor comprising a sensor portion, the sensor portion comprising:

a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element, **[and a plurality of thin film transistors,**

wherein the pixel includes a photodiode, an electroluminescence element,] a switching TFT, an electroluminescence driving TFT, a reset TFT, a buffer TFT and a selective TFT, wherein:

the switching TFT and the electroluminescence driving TFT control light emission of the electroluminescence element,

light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,

the photodiode and the plurality of thin film transistors generate an image signal from the light **[radiated]** reflected to the photodiode,

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the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

6. (Amended) An area sensor according to claim 2, wherein the N-type semiconductor layer comprises polysilicon.

7. (Amended) An area sensor according to claim 3, wherein the N-type semiconductor layer comprises polysilicon.

8. (Amended) An area sensor according to claim 4, wherein the N-type semiconductor layer comprises polysilicon.

10. (Amended) An area sensor according to claim 2, wherein the P-type semiconductor layer comprises polysilicon.

11. (Amended) An area sensor according to claim 3, wherein the P-type semiconductor layer comprises polysilicon.

12. (Amended) An area sensor according to claim 4, wherein the P-type semiconductor layer comprises polysilicon.

13. (Amended) An area sensor according to claim 1, wherein the **[electric]** photoelectric conversion layer comprises amorphous silicon.

14. (Amended) An area sensor according to claim 2, wherein the **[electric]** photoelectric conversion layer comprises amorphous silicon.

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15. (Amended) An area sensor according to claim 3, wherein the **[electric] photoelectric** conversion layer comprises amorphous silicon.

16. (Amended) An area sensor according to claim 4, wherein the **[electric] photoelectric** conversion layer comprises amorphous silicon.

21. (Amended) An area sensor according to claim 1, wherein **[an] the area sensor is included in** electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

22. (Amended) An area sensor according to claim 2, wherein **[an] the area sensor is included in** electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

23. (Amended) An area sensor according to claim 3, wherein **[an] the area sensor is included in** electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

24. (Amended) An area sensor according to claim 4, wherein **[an] the area sensor is included in** electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

25. (Amended) A display apparatus comprising a sensor portion, the sensor portion comprising:

a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,

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wherein:

the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**

the photoelectric conversion layer is made of an amorphous semiconductor film, and

the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

26. (Amended) A display apparatus comprising a sensor portion, the sensor portion comprising:

a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,

wherein:

a light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,

the photodiode generates an image signal from the light **[radiated]** reflected to the photodiode,

the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**

the photoelectric conversion layer is made of an amorphous semiconductor film, and

the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

27. (Amended) A display apparatus comprising a sensor portion, the sensor portion comprising:

a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element and a plurality of thin film transistors,

wherein:

the plurality of thin film transistors control light emission of the electroluminescence element,

a light emitted from the electroluminescence element is reflected from a subject to be

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radiated to the photodiode,
the photodiode and the plurality of thin film transistors generate an image signal from the light **[radiated]** reflected to the photodiode,
the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**
the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

28. (Amended) A display apparatus comprising a sensor portion, the sensor portion comprising:

a plurality of pixels, each of the plurality of pixels comprising a photodiode, an electroluminescence element, **[and a plurality of thin film transistors,**

wherein the pixel includes a photodiode, an electroluminescence element,] a switching TFT, an electroluminescence driving TFT, a reset TFT, a buffer TFT and a selective TFT, wherein:

the switching TFT and the electroluminescence driving TFT control light emission of the electroluminescence element,

light emitted from the electroluminescence element is reflected from a subject to be radiated to the photodiode,

the photodiode and the plurality of thin film transistors generate an image signal from the light **[radiated]** reflected to the photodiode,

the photodiode includes a photoelectric conversion layer that is in contact with a part of a P-type semiconductor layer and an N-type semiconductor layer, **[and]**

the photoelectric conversion layer is made of an amorphous semiconductor film, and
the photoelectric conversion layer is thicker than the P-type semiconductor layer and the N-type semiconductor layer.

30. (Amended) **[An area sensor]** A display apparatus according to claim 26, wherein the N-type semiconductor layer comprises polysilicon.

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31. (Amended) [**An area sensor**] A display apparatus according to claim 27, wherein the N-type semiconductor layer comprises polysilicon.

32. (Amended) [**An area sensor**] A display apparatus according to claim 28, wherein the N-type semiconductor layer comprises polysilicon.

33. (Amended) [**An area sensor**] A display apparatus according to claim 25, wherein the P-type semiconductor layer comprises polysilicon.

34. (Amended) [**An area sensor**] A display apparatus according to claim 26, wherein the P-type semiconductor layer comprises polysilicon.

35. (Amended) [**An area sensor**] A display apparatus according to claim 27, wherein the P-type semiconductor layer comprises polysilicon.

36. (Amended) [**An area sensor**] A display apparatus according to claim 28, wherein the P-type semiconductor layer comprises polysilicon.

37. (Amended) [**An area sensor**] A display apparatus according to claim 25, wherein the [**electric**] photoelectric conversion layer comprises amorphous silicon.

38. (Amended) [**An area sensor**] A display apparatus according to claim 26, wherein the [**electric**] photoelectric conversion layer comprises amorphous silicon.

39. (Amended) [**An area sensor**] A display apparatus according to claim 27, wherein the [**electric**] photoelectric conversion layer comprises amorphous silicon.

40. (Amended) [**An area sensor**] A display apparatus according to claim 28, wherein the [**electric**] photoelectric conversion layer comprises amorphous silicon.

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41. (Amended) **[An area sensor]** A display apparatus according to claim 25, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

42. (Amended) **[An area sensor]** A display apparatus according to claim 26, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

43. (Amended) **[An area sensor]** A display apparatus according to claim 27, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

44. (Amended) **[An area sensor]** A display apparatus according to claim 28, wherein the electroluminescence element has a positive electrode, a negative electrode and an electroluminescence layer provided between the positive electrode and the negative electrode.

45. (Amended) **[An area sensor]** A display apparatus according to claim 25, wherein **[an] the display apparatus is included in** electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

46. (Amended) **[An area sensor]** A display apparatus according to claim 26, wherein **[an] the display apparatus is included in** electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

47. (Amended) **[An area sensor]** A display apparatus according to claim 25, wherein **[an] the display apparatus is included in** electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a

notebook computer and a portable information terminal.

48. (Amended) **[An area sensor]** A display apparatus according to claim 25, wherein **[an]** the display apparatus is included in electronic equipment **[using the area sensor is an equipment, which is]** selected from the group of: a video camera, a digital still camera, a notebook computer and a portable information terminal.

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